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REVIEW OF THE INFORMATION FOR THE IDENTIFICATION OF CRITICAL HABITAT FOR THE COWICHAN (VANCOUVER) LAMPREY

Cowichan (Vancouver) Lamprey (R.J. Beamish 1980 photo credit)

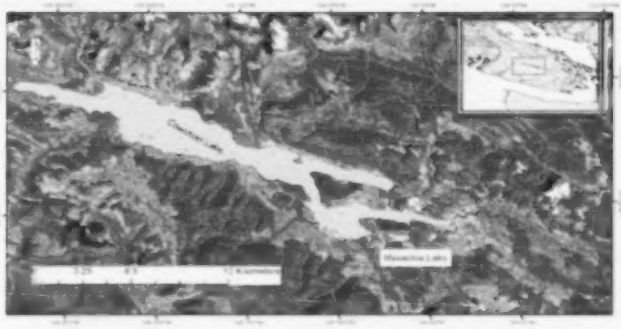

Figure 1. Cowichan and Mesachie lakes and associated tributaries

Context

Entosphenus macrostomus was formerly commonly known as the Vancouver Lamprey and is recognized as such on the Species at Risk public registry. Recent efforts have been made to identify the species with its more appropriate common name of Cowichan Lamprey which will be used in this document.

The Cowichan (Vancouver) Lamprey is a species derived from the Pacific Lamprey (E. tridentatus) and is reported only in Cowichan, Mesachie and Bear lakes on Vancouver Island, British Columbia. E. macrostomus was originally named Lampetra macrostoma (Beamish (1982). It was deemed a separate species based on its unique morphological and physiological traits, primarily its large oral disk and physiological adaptation to freshwater. The species designation was confirmed using microsatellite DNA analysis and was reclassified as E. macrostomus by the American Fisheries Society in 2013.

Limited research has been conducted on this species since the 1980s and there is no estimate of population abundance. Its extreme endemic distribution suggests that the species will always remain at some risk, and it has been designated as Threatened on Schedule 1 of the Species at Risk Act (SARA).

A variety of factors threaten Cowichan Lamprey and its associated habitat, though the extent and severity of threats are unknown. Further research will be required to confirm the extent and likelihood of destruction to Critical Habitat or "the habitat that is necessary for the survival or recovery of a listed species and that is identified as the species' Critical Habitat in the recovery strategy or action plan for the species". Under SARA s41(1)(c) a species' Critical Habitat must be identified to the extent possible, based on the best available information.

The Fisheries and Oceans Canada SARA Management Program has requested science advice in support of the identification of Critical Habitat and residence, and development of the Action Plan for the Cowichan Lamprey under SARA.

This Science Advisory Report is from the October 30, 2013 Review of the Information for the

Identification of Critical Habitat for Cowichan (Vancouver) Lamprey. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.

SUMMARY

- *Entosphenus macrostomus* (Cowichan Lamprey) has only been identified in Cowichan, Mesachie and Bear lakes. They have not been identified in the Cowichan River although no barrier exists preventing their movement into the river.
- Cowichan Lamprey was described as a distinct species in 1982. Since then, limited research has been conducted on its biology, ecological role, and habitat requirements.
- No recent reliable quantitative population estimates exist for Cowichan Lamprey. The population was estimated to be about 1,000 to 2,000 adults in 1988 and based on limited trapping studies in Mesachie Lake in recent years it is thought that the population may have declined since that time. In addition, reports of scars and wounds on salmon in the lake has varied over this period and may suggest fluctuations in the lamprey population. However using scars as an index of abundance is problematic as the information is opportunistic and dependent on reporting by fishermen.
- Habitat requirements vary depending on the life stage of lamprey. The lakes are required for feeding adults. Spawning adults use the nearshore habitat and fluvial fan regions of tributaries entering the lakes. The presence of ammocoetes in the lower portions of these tributaries suggests that some spawning may also occur in these stream regions. Habitat for burrowing ammocoetes requires medium-fine to fine substrates with a layer of organic debris.
- During spawning, lamprey build nests which could be considered residences as they are discrete dwelling places. Adults of both sexes invest energy, physically moving pebbles with their oral discs to create the nests; the nests support the life-cycle process of spawning and egg incubation and are occupied by multiple individuals for a period of time.
- The primary activities likely to destroy Critical Habitat include, but are not limited to: land-based activities that have the capacity to directly or indirectly alter their aquatic habitat including forestry, mining, and land development; water withdrawals or impoundments that alter the natural variability in water flow; releases of deleterious substances into the watershed; riparian vegetation removal; activities that result in significant sediment inputs; and overfishing of prey species.
- The high uncertainty of a number of factors related to Cowichan Lamprey make the identification of Critical Habitat difficult. These factors include, but are not limited to: the type of vegetation required to maintain the functions of the riparian zone; the quality of sites suitable for spawning; the location of spawning sites; distribution and habitat associations of ammocoetes in the lake; and abundance and type of prey species. Therefore, further work is suggested to provide quantitative and qualitative thresholds for Critical Habitat attributes.
- It is recommended that the critical habitat for the Cowichan Lamprey include Cowichan, Bear and Mesachie lakes in their entirety, the adjoining waterways and 100 metres upstream of tributaries into the lakes.

INTRODUCTION

The Cowichan Lamprey (*E. macrostomus*) is a parasitic species of lamprey derived from the Pacific Lamprey (*E. tridentatus*). It has only been identified in the Cowichan, Mesachie and Bear lakes on Vancouver Island, British Columbia. Cowichan Lamprey have not been found in the Cowichan River despite no barriers limiting access. The adult form is parasitic. *E. macrostomus* was deemed a separate species based on its unique morphological and physiological traits, primarily its large oral disk and physiological adaptation to freshwater.

Cowichan Lamprey was listed in 2003 as Threatened under the Species at Risk Act (SARA) and a Recovery Strategy for the species was completed in 2007. A recovery strategy or action plan must identify an endangered species' Critical Habitat, or "the habitat that is necessary for the survival or recovery of a listed species and that is identified as the species Critical Habitat in the recovery strategy or action plan for the species". Under SARA s41(1)(c) a species' Critical Habitat must be identified to the extent possible, based on the best available information.

ASSESSMENT

Critical Habitat is defined in the Species at Risk Act (2002) section 2(1) as "the habitat that is necessary for the survival or recovery of a listed wildlife species and that is identified as the species' Critical Habitat in the recovery strategy or in an action plan for the species".

The identification of Critical Habitat in the context of SARA must:

- Specify the geospatial location of the Critical Habitat or describe the area within which Critical Habitat is found.
- Describe the known biophysical functions, features and attributes of that Critical Habitat that are required by the listed wildlife species in order to carry out life processes necessary for its survival or recovery.
- Provide a sufficient level of detail to allow a person to determine whether a particular location is part of Critical Habitat.

Cowichan Lamprey spawn in nests constructed by both sexes. After hatching the habitat for lamprey ammocoetes is generally defined as medium fine to fine sediment areas but the depth and spatial distribution is poorly understood. The number of years that the Cowichan Lamprey remain in their larval form (ammocoetes) is not known but it has been suggested to be about six years. Metamorphosis occurs between July and October, and the young adults remain buried, and active feeding on live fish in the lakes is believed to begin the following year. It has been suggested that spawning occurs the subsequent spring or summer, after a year of active feeding.

No recent population estimates exist for the Cowichan Lamprey. In 1998 it was estimated that 1000 to 2000 adults may have lived in the lakes at that time but that abundance fluctuates over time. The magnitude of frequency of fluctuations was not known but it has been suggested that it is a response to prey availability. Recent trapping studies in Mesachie Lake suggest a possible decline in the population of Cowichan Lamprey in the last fifteen years.

Adult and Metamorphosing Lamprey

Habitat requirements for the juvenilles and adult feeding forms of the Cowichan Lamprey are not known. It has been suggested that the young newly metamorphosed lamprey remain buried in substrate over winter prior to commencing active feeding. Scarring of sport-caught fish in Cowichan and Mesachie lakes may exceed 80% and indicate that the adult lamprey are actively

feeding in these regions. However, these scarring rates are determined opportunistically through fishing derbies and should be considered an indication only. Spawning Cowichan Lamprey are most easily captured during spawning. Feeding adults are in the water column of the lakes and are most commonly caught when feeding on prey that is captured in the sport fishery. The distribution and abundance of feeding adults is not known.

Spawning Lamprey and Egg Incubation

The habitat requirements of Cowichan Lamprey are not known in detail. It is documented that they use the nearshore lake habitat. However, the presence of ammocoetes in the lower portions of tributaries to the lakes suggest that spawning may also occur in these regions or that ammocoetes are moving up the tributaries to feed and grow. Lamprey require pebbles or gravel of a size that can be moved either by mouth or with their bodies to build their nests. Spawning aggregations on shallow gravel deltas near the mouth of tributaries with water depths of 0.2 to 2m were observed in the 1990s. The maximum depth for spawning is not known.

Ammocoetes

Once lamprey eggs hatch, the ammocoetes burrow into medium-fine to fine sediments or sand. These regions are predominantly in fluvial fans of streams where there is a layer of organic debris composed of decaying leaves or aquatic vegetation. Lower numbers of ammocoetes have been found in fine silt or clay substrates or on hard-bottom, boulder-covered regions. The depth distribution of ammocoetes is not known as surveys have only examined to depths that can be effectively fished using electroshocking equipment. Although the period that Cowichan Lamprey remain as ammocoetes is not confirmed it is suggested to be about six years.

Cowichan Watershed

Cowichan and Mesachie lakes are oligotrophic, typical of coastal BC lake systems. They have surface areas of 6,204 ha and 59.3 ha respectively. They are part of the Cowichan River watershed, with the waters of Mesachie Lake flowing into Lake Cowichan at the eastern end of the lake. The water temperatures of the lakes range from a low of 4°C in winter to 24°C in summer (summer 2005). Anadromous salmon are found in the lake. Resident fish populations include brown, rainbow and cutthroat trout, Dolly Varden char and Kokanee salmon. In addition, there are smallmouth bass, prickly sculpin, and threespine stickleback.

Riparian Area Width

Riparian areas play an important part in preserving and contributing to the characteristics of aquatic ecosystems. In order to define the width of the riparian buffer that should be included in the Critical Habitat being identified for Cowichan Lamprey, it is recommended that the British Columbia Riparian Area Regulation (RAR) methodology or other applicable tool be applied to the tributaries of Cowichan, Bear and Mesachie lakes as required. Protection of the riparian area would, allow for the maintenance of stream stability and prevent the input of sediments that may negatively affect the fluvial fan feature that supports ammocoete rearing and adult spawning for Cowichan Lamprey. In the absence of a full assessment, it is recommended that tributaries be considered critical area 100 m upstream of Cowichan, Bear or Mesachie lakes. In addition, the riparian vegetation around the lakes is important for supporting ammocoete rearing and feeding. This may be most critical in Mesachie Lake which has a much smaller area and only one main tributary. It is recommended that this (riparian) vegetation be considered a Critical Habitat feature.

Anthropogenic Activities

There is a long history of anthropogenic activities on Lake Cowichan. A few of these include timber harvesting, fishing, residential and commercial development, and recreation activities. Commercial logging has been occurring in the area since as early as 1879 and log booming on the lake has occurred since 1912. Although there is currently active logging in the area it has declined in recent years. Urban development and recreational fishing and boating are more recent pressures on the system.

Biophysical Functions, Features and Attributes of Proposed Critical Habitat for Cowichan Lamprey

The proposed Critical Habitat described here is believed to be necessary for Cowichan Lamprey survival. Table 1 summarizes the best available knowledge of the functions, features and attributes needed for each life-stage of Cowichan Lamprey. Note that not all attributes in Table 1 would need to be present in order for a feature to be identified as Critical Habitat. If the features as described in Table 1 are present and capable of supporting the associated function(s), the feature should be considered Critical Habitat even though some of the associated attributes might be outside of the range indicated in the table.

Table 1. General summary of the biophysical functions, features and attributes for E. macrostomus in Cowichan Lake, Mesachie Lake, adjoining waterways and adjacent tributaries.

Life stage	Function	Feature	Attribute
Eggs	Incubation	Nest	- Pebbles no greater than 1 cm diameter - Hard substrate covered with small pebbles/sediment - Mean depth nest into substrate mean ~ 30 cm - Water quality parameters (oxygen, temperature and pH) within the natural range of variation. - Few or no added pollutants
Ammocoetes	Feeding and rearing	Fluvial fans from streams flowing into lake habitat	- Low to medium water flow - Loose silt, sand or mud substrate - Free flowing water - Water quality parameters (oxygen, temperature and pH) within the natural range of variation - Adequate supply of detritus for food
Adults	Spawning	Fluvial fans from streams flowing into lake habitat	- Pebbles no greater than 1 cm diameter for building nests - Hard substrate covered with small pebbles/sediment - Mean depth nest into substrate mean ~ 30 cm - Water quality parameters (oxygen, temperature and pH) within the natural range of variation - Few or no added pollutants
	Feeding	Lake habitat	- Prey availability (exact species unknown) - Water quality parameters (oxygen, temperature and pH) within the natural range of variation

Activities Likely to Destroy Critical Habitat

There is a wide variety of anthropogenic activities of concern for the recovery and survival of the Cowichan Lamprey, although further research will be required to determine the potential impact of each activity on the Critical Habitat of the Lamprey.

Activities that are likely to permanently or temporarily destroy Critical Habitat for Cowichan Lamprey, include, but are not limited to the following:

- land-based activities which have the capacity to alter aquatic habitat directly (e.g. impacts to riparian habitat, alteration of run-off rates or water storage capacity in headwaters) or indirectly (e.g. changes to water quality through introduction of pollutants). These activities include forestry, mining, and land development for industrial or residential uses;
- water withdrawals and/or impoundment that result in water fluctuations that are greater than natural variability;
- release of deleterious substances (e.g. hydrocarbons, pollutants and toxins);
- riparian vegetation removal within the defined areas around the stream and inflowing streams, or activities that degrade the normal function of riparian zones;
- activities that generate significant sediment inputs into adjacent water bodies. Although turbidity values cannot be provided at this time, significant sediment influx into the stream could impair the osmoregulatory capacity of the animal. However, if water flows are maintained within natural variability it is unlikely that the water course would dry up from deposition of sediment;
- overfishing of prey species; and,
- introduction of aquatic invasive species.

Residence

Cowichan Lamprey construct nests for spawning in the fluvial fans of tributaries. These nests are considered residences under SARA while they are being used for spawning or egg incubation (between May to August):

- They are discrete dwelling places that have a form and function similar to that of a nest.
- Adult Lamprey of both sexes make an investment in creating a nests by using their bodies to excavate the depression and their oral disc to carry pebbles for the nest.
- The nests have the functional capacity to support the essential life-cycle processes of spawning and egg incubation.
- The nests are occupied by multiple individuals during spawning and egg incubation.

Sources of Uncertainty

- There is currently no estimate of population abundance; however, it may be possible to develop a relative index of abundance using scar or wound rates on prey species.
- Presence and distribution of lamprey in streams flowing into the lakes is uncertain.
- The abundance of prey species is unknown.
- Distribution and habitat associations of ammocoetes in the lakes is unclear, and the value of lakeside riparian areas to ammocoete rearing and feeding is unknown.

- Additionally, recent stream surveys have not regularly included areas outside of fluvial fan regions of stream to further define the features and attributes required for rearing and feeding ammocoetes.
- The effects of water removal during normal operation, and in years of drought, on the habitat availability and change in habitat structure in the nearshore area is unknown. Water draw-down is most significant in the summer when lamprey are spawning and rearing young ammocoetes in the nearshore area.
- Most recent surveys have been conducted in years of extreme low and extreme high water levels, thus surveys during "normal" water level years are rare.
- Lamprey in spawning condition have been confirmed from only one location. Extremely small ammocoetes (<5cm) have been captured in several places in Cowichan Lake, suggesting nearby spawning areas; however this has not been confirmed.

CONCLUSIONS AND ADVICE

Based on the best available information the critical habitat for the Cowichan Lamprey is recommended using the bounding box approach as Cowichan, Bear and Mesachie lakes in their entirety, the adjoining waterways and 100 metres upstream of tributaries into the lakes.

Additional surveys during the spawning period are recommended to identify spawning locations in lakes and streams, and provide additional details describing the features and attributes of these areas as spawning locations may vary from year to year due to environmental conditions.

The vegetation around the streams is an attribute of the stream feature that supports ammocoete rearing (estimated up to six years) and potential spawning. The use of a science-based tool to identify appropriate riparian width is recommended. The vegetation around the stream supports the stream stability and prevents the input of sediments that may negatively affect the fluvial fan feature that supports ammocoete rearing and adult spawning.

An adequate food supply of detritus, from sources such as macrophytes, riparian (near shore) vegetation or other sources is an important attribute of Critical Habitat features that support ammocoete rearing and feeding.

Residence includes the nests that Cowichan Lamprey construct within their range during the period they are being used for spawning or egg incubation.

SOURCES OF INFORMATION

This Science Advisory Report is from the October 30, 2013 Review of the Information for the Identification of Critical Habitat for Cowichan (Vancouver) Lamprey. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.

Beamish, R.J. 1982. *Lampetra macrostoma*, a new species of freshwater parasitic lamprey from the west coast of Canada. Canadian Journal of Fisheries and Aquatic Sciences 39: 736-747

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